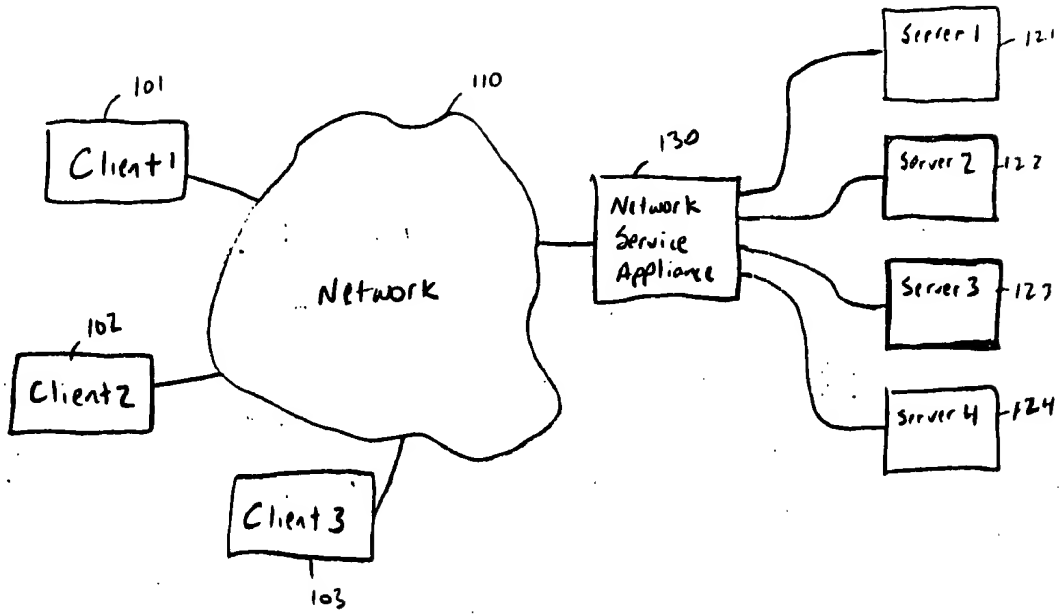
101
Client1
110
Network
130
Network Service Appliance
Server 1
121
Server 2
122
Server 3
123
Server 4
124
102
Client2
Client 3
103

Figure 1

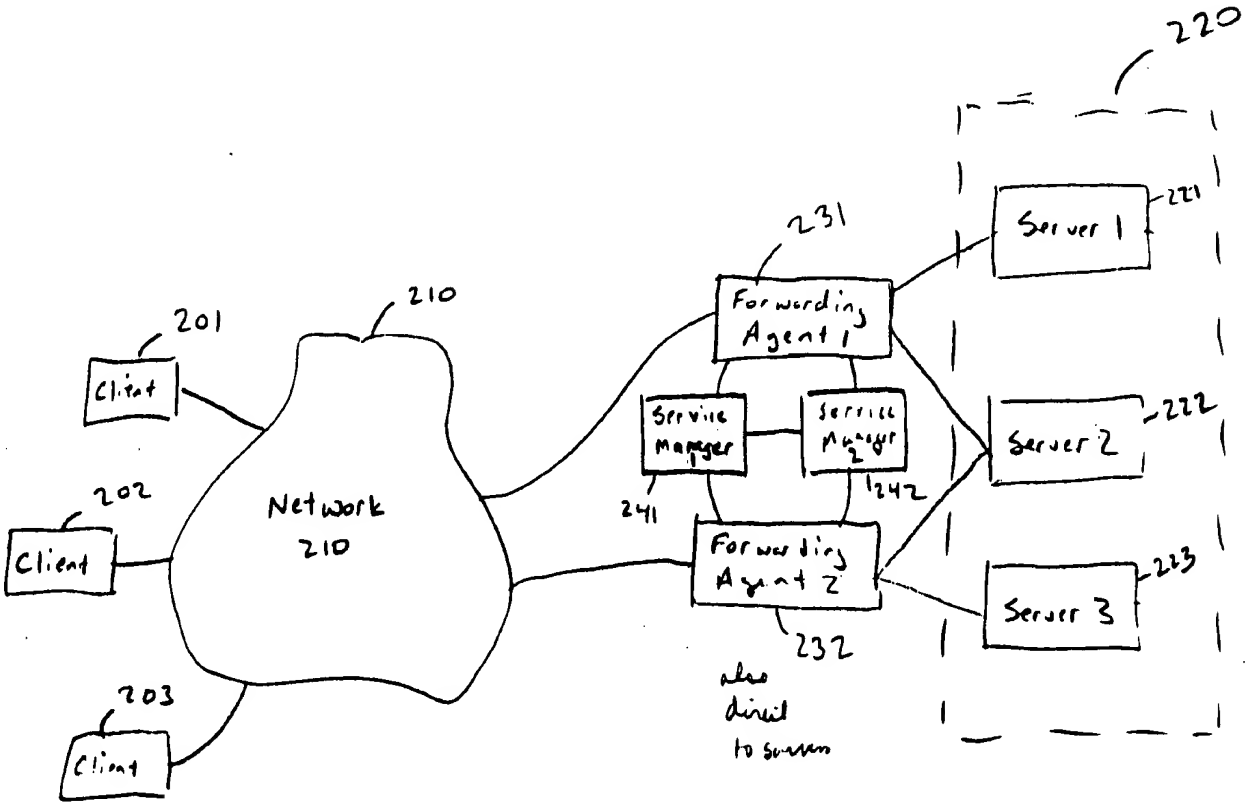
220
231
Server 1
221
Forwarding Agent 1
201
210
Client
Service Manager
Service Manager 2
Server 2
222
202
241
242
Network 210
Client
Forwarding Agent 2
223
Server 3
232
also direct to server
203
Client

Figure 2A

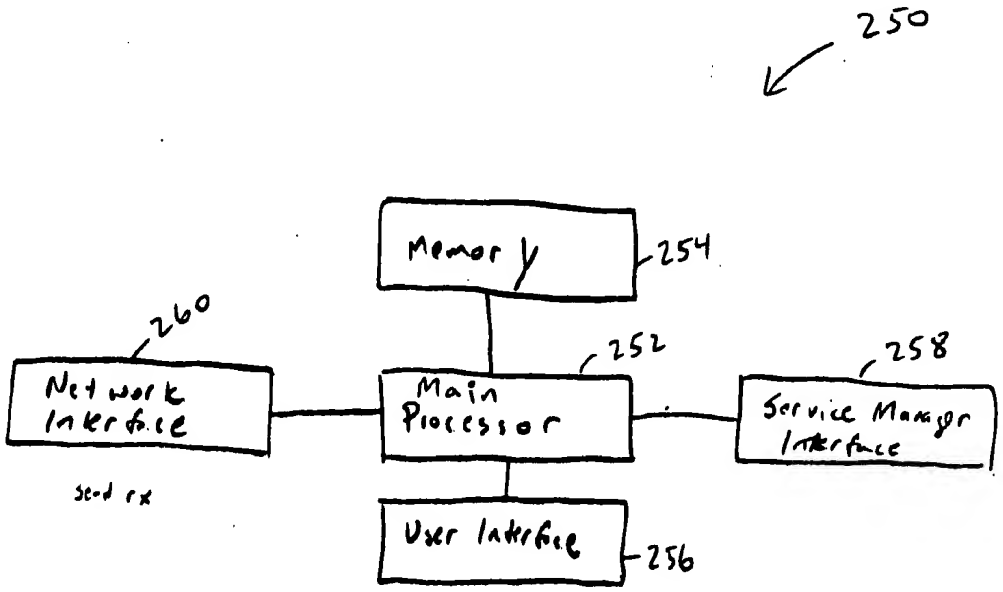
250
Memory
254
260
Network Interface
252
Main Processor
258
Service Manager Interface
User Interface
256

Figure 2B

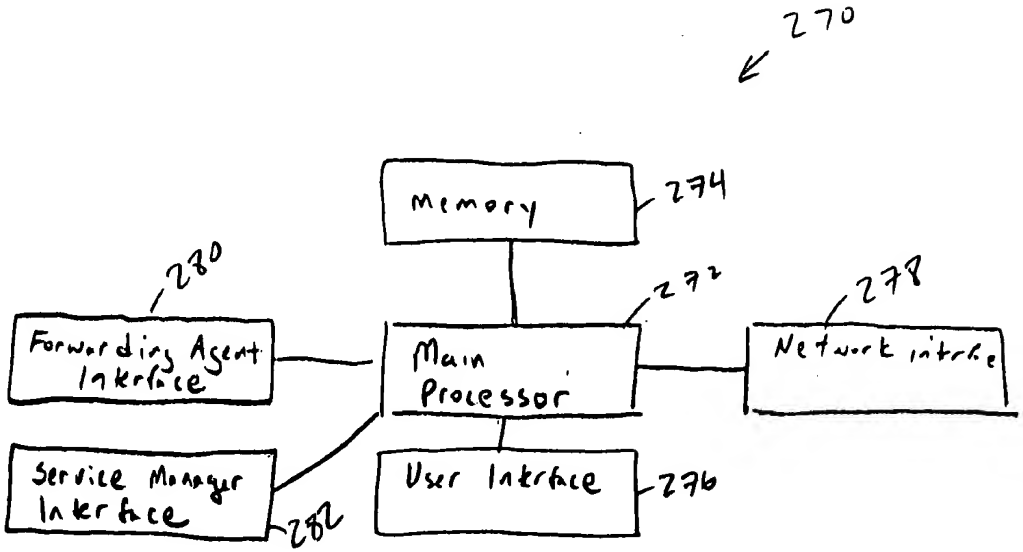

Figure 2C

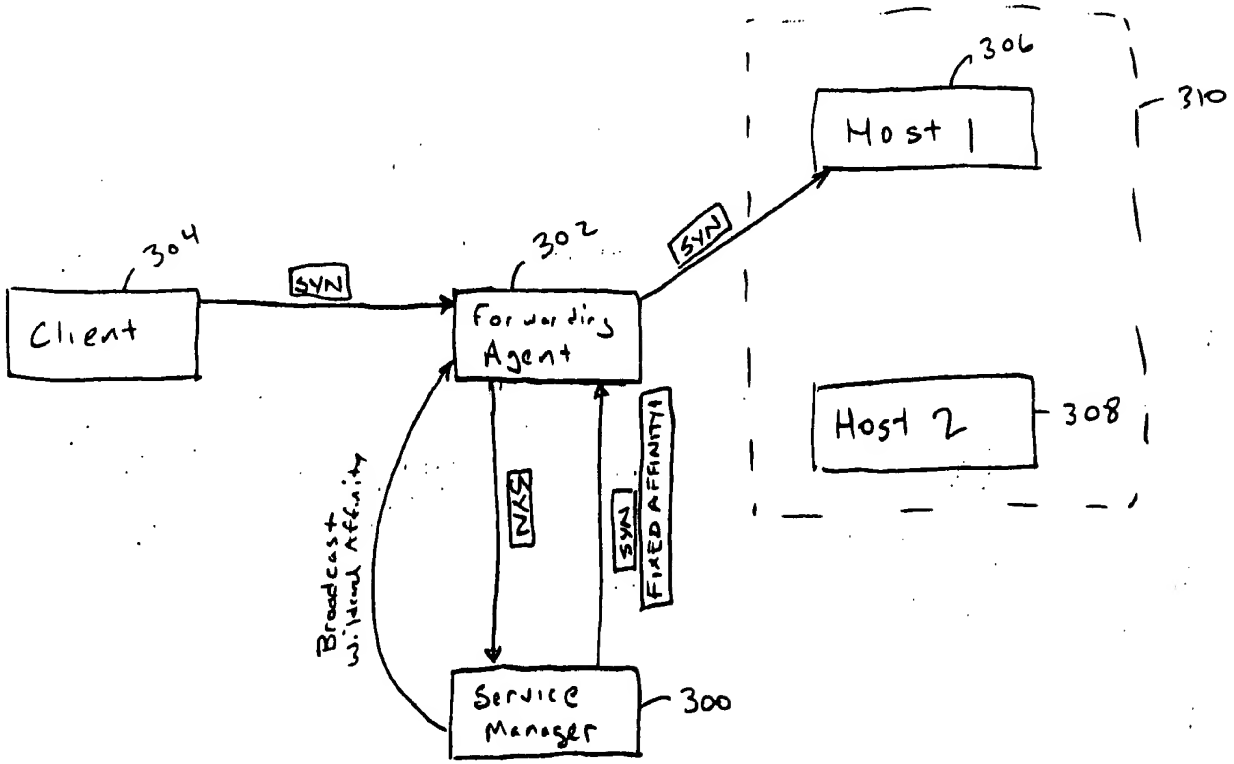
306
310
Host 1
304
SYN
302
SYN
Client
Forwarding Agent
Host 2
308
Broadcast with Affinity
NKS
SYN
FIXED AFFINITY
Service Manager
300

Figure 3A

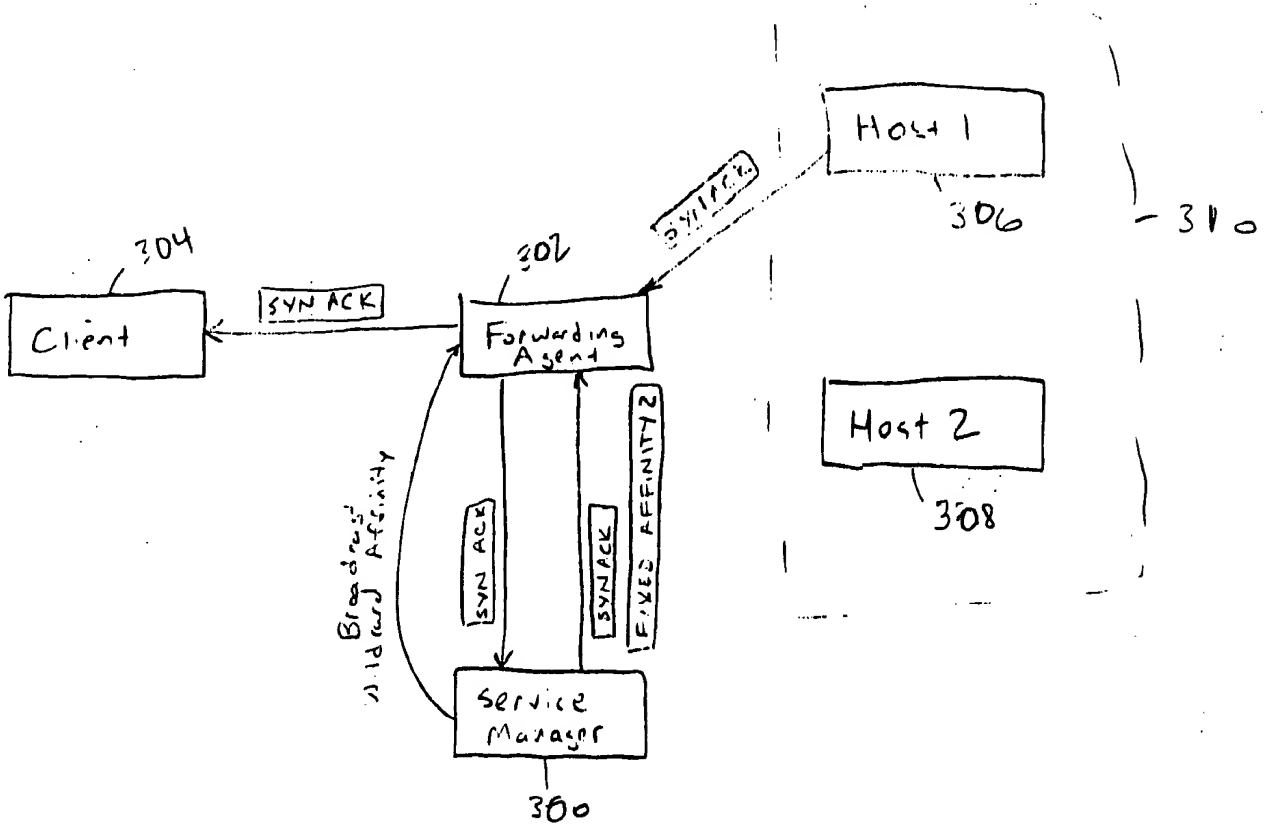
Host 1
306
310
304
302
SYN ACK
SYN ACK
Client
Forwarding Agent
Host 2
308
SYN ACK
SYN ACK
FIXED AFFINITY
Broadcast Affinity
Service Manager
300

Figure 3B

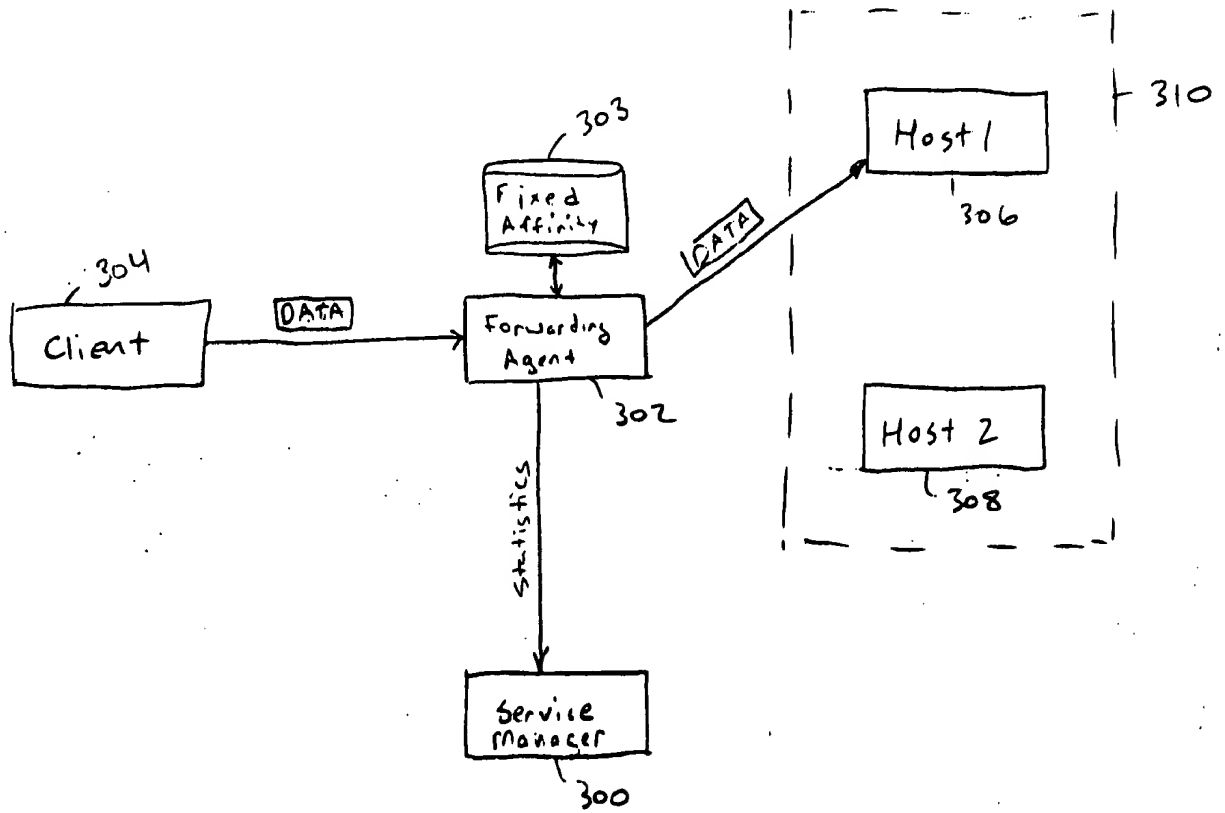
303
Fixed Affinity
304
Client
DATA
Forwarding Agent
302
DATA
Host 1
306
310
Host 2
308
statistics
Service Manager
300

Figure 3C

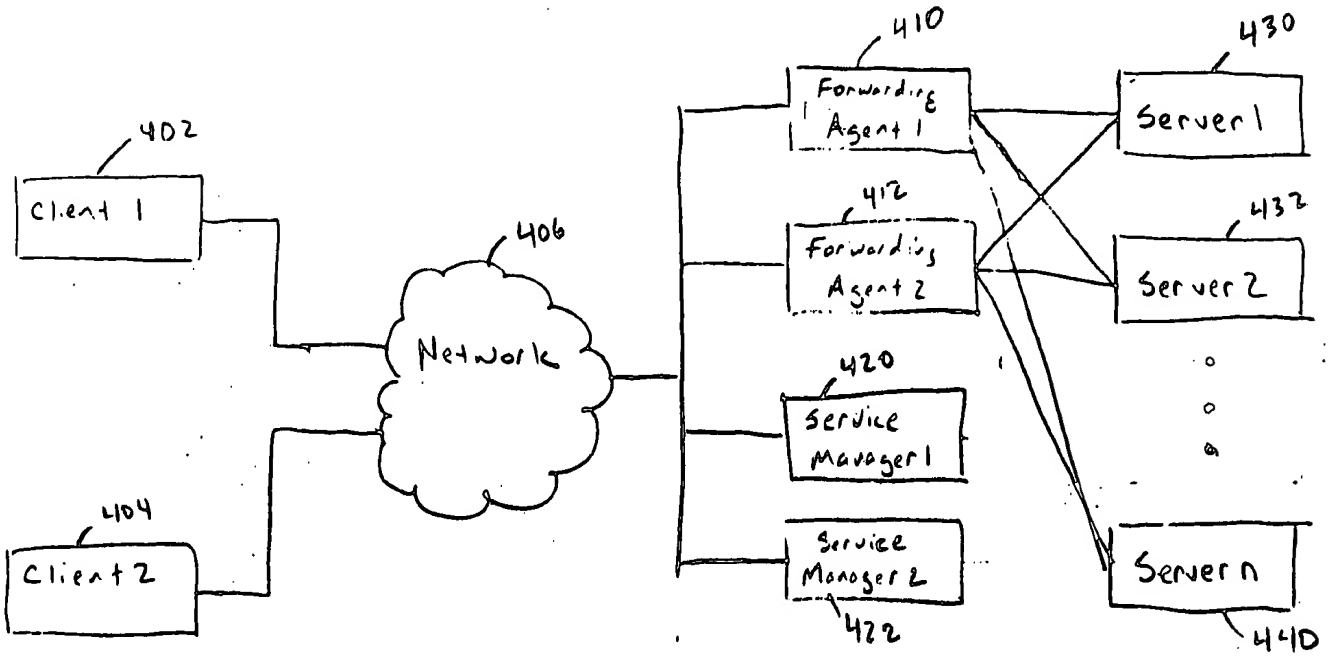
410
Forwarding Agent 1
430
Server 1
402
Client 1
412
Forwarding Agent 2
432
Server 2
406
Network
420
Service Manager 1
Server n
404
Client 2
Service Manager 2
422
440

Figure 4

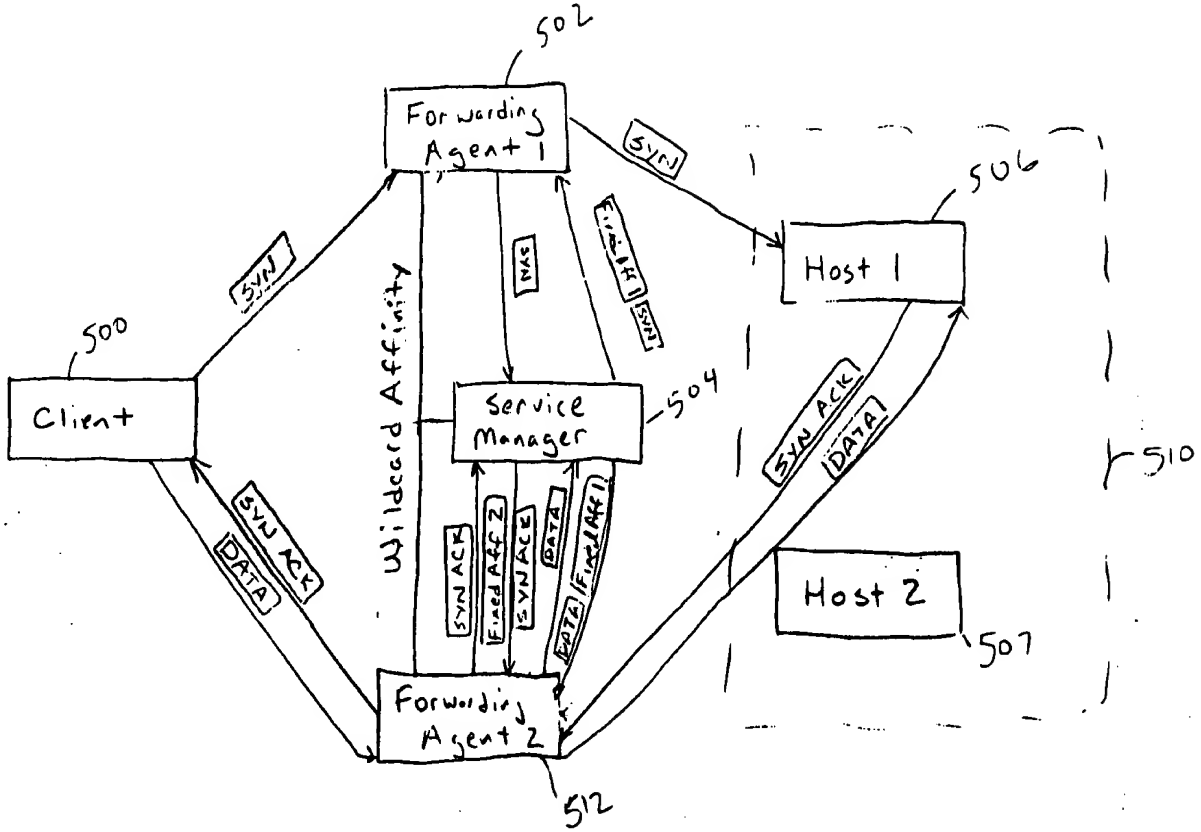
502
Forwarding Agent 1
SYN
506
Host 1
SYN
Fixed Aff 1
SYN
500
Client
Service Manager
504
Wildcard Affinity
SYN ACK
DATA
SYN ACK
Fixed Aff 2
SYN ACK
DATA
DATA
Fixed Aff 1
SYN ACK
DATA
510
Host 2
507
Forwarding Agent 2
512

Figure 5

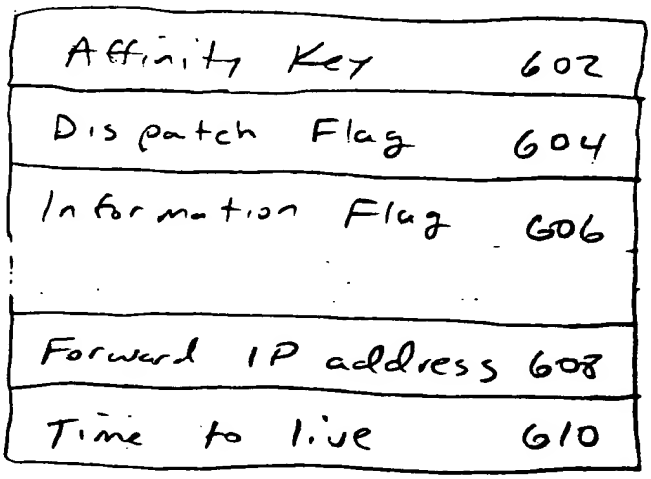
Affinity Key 602
Dispatch Flag 604
Information Flag 606
Forward IP address 608
Time to live 610
600

Figure 6

700

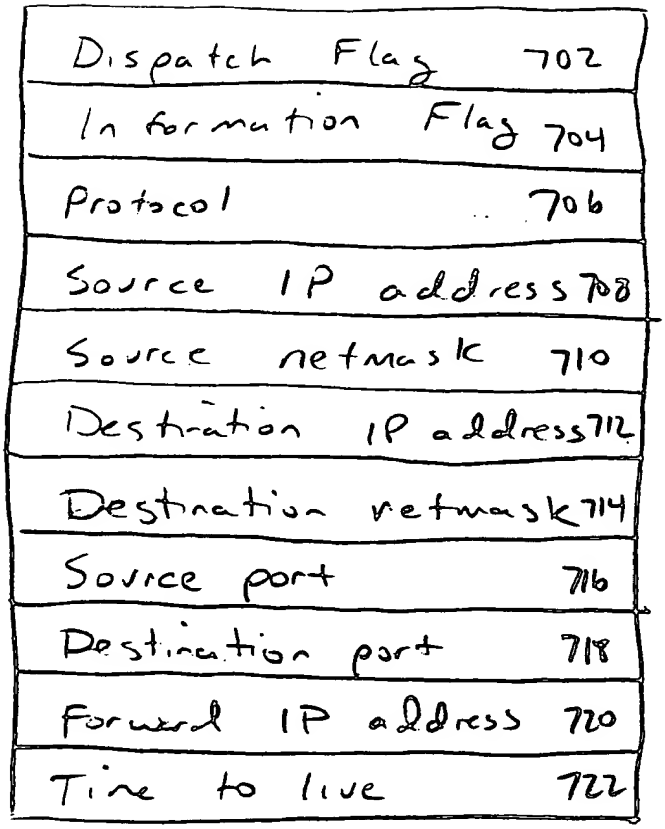
Dispatch Flag 702
Information Flag 704
Protocol 706
Source IP address 708
Source netmask 710
Destination IP address 712
Destination netmask 714
Source port 716
Destination port 718
Forward IP address 720
Time to live 722

Figure 7

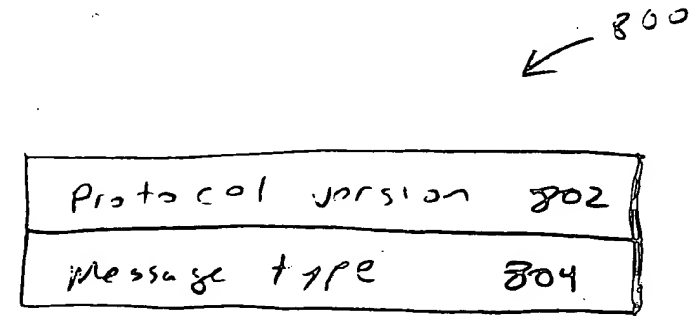

Figure 8A

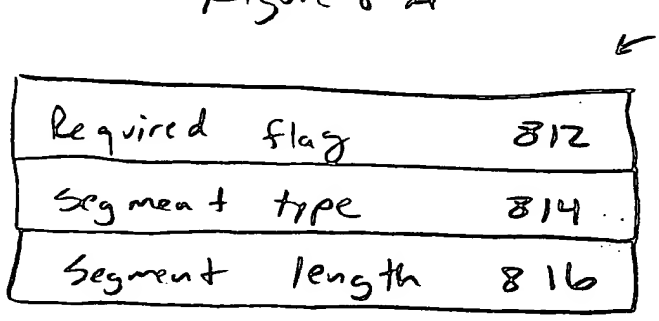

Figure 8B

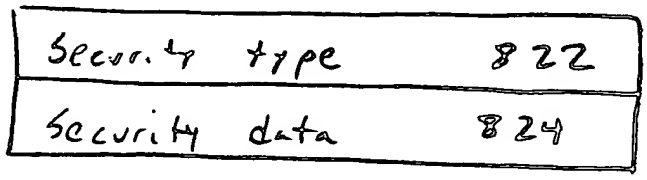

Figure 8C

Service message header 907	← 900
Security Segment	903
Wild Card affinity	904
Action List	906
Affinity service precedence	908
Backup service precedence	909
Interest data	910
Service manager interest data	912
Action segments	914

Figure 9A

← 920

Service message header	922
Security segment	924
Fixed affinity	926
Affinity service precedence	928
Backup service precedence	929
Action segments	930
Identity information	932
Service manager interest data	934
Forwarding agent interest data	936
IP packet segment	938

Figure 9B

Service message header	941
Security segment	942
Action list segment	944
Affinity Segment (from original affinity)	946
Identity information (from original affinity)	948
Service manager interest data	950
Forwarding agent interest data	952

940

Figure 9C

Service message header	962
Security Segment	964
Affinity Identifier	966
Identity information (from original affinity	968
Service manager interest data	970
Forwarding agent interest data	972
IP packet Segment	974

960

Figure 9D

Service message header	982
IP packet segment	984

980

Figure 9E

1000

Dispatch Flag	1002
Information Flag	1004
Affinity key	1006
Interest mask	1008

Figure 10 A

1010

Search order Flag	1012
Precedence value	1014

Figure 10 B

1020

Service Manager Interest Data	1021

Figure 10 C

1022

Forwarding Agent Interest Data	1023

Figure 10 D

1024

IP address of Sender	1025
Character host name	1026

Figure 10 E

1030

Source IP address	1032
Destination IP address	1034
Source port	1036
Destination port	1038

Figure 10F

1040

Sequence delta	1042
Initial sequence number	1044
Acknowledgment delta	1046
Initial Acknowledgment number	1048

Figure 10G

1050

Advertise address	1052
Subnet mask	1054

Figure 10H

1060

Interest IP Address	1062
Interest Port	1064
Interest Mask	1066
Data Flag	1067
Copy Flag	1068
Hold Flag	1069

Figure 10I

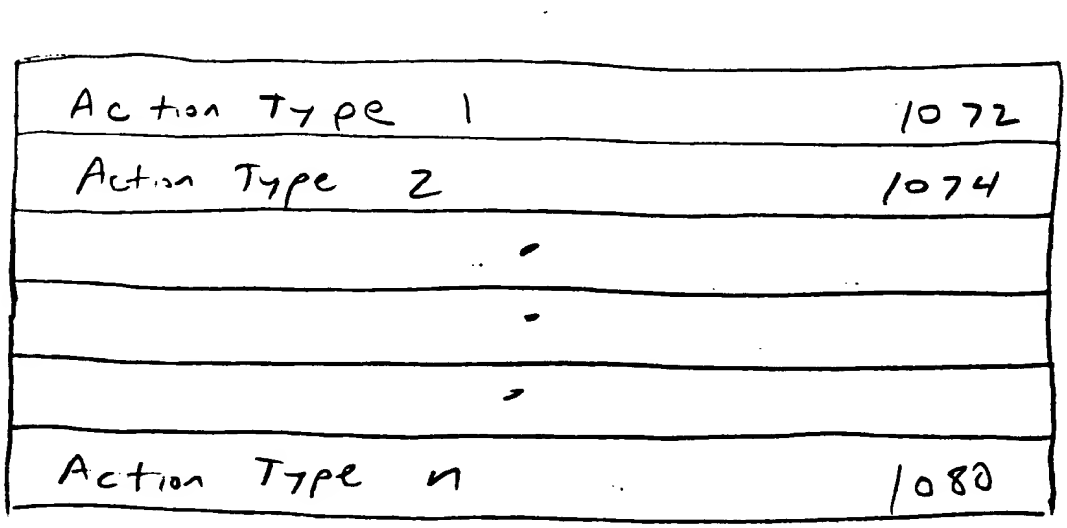

Figure 10J

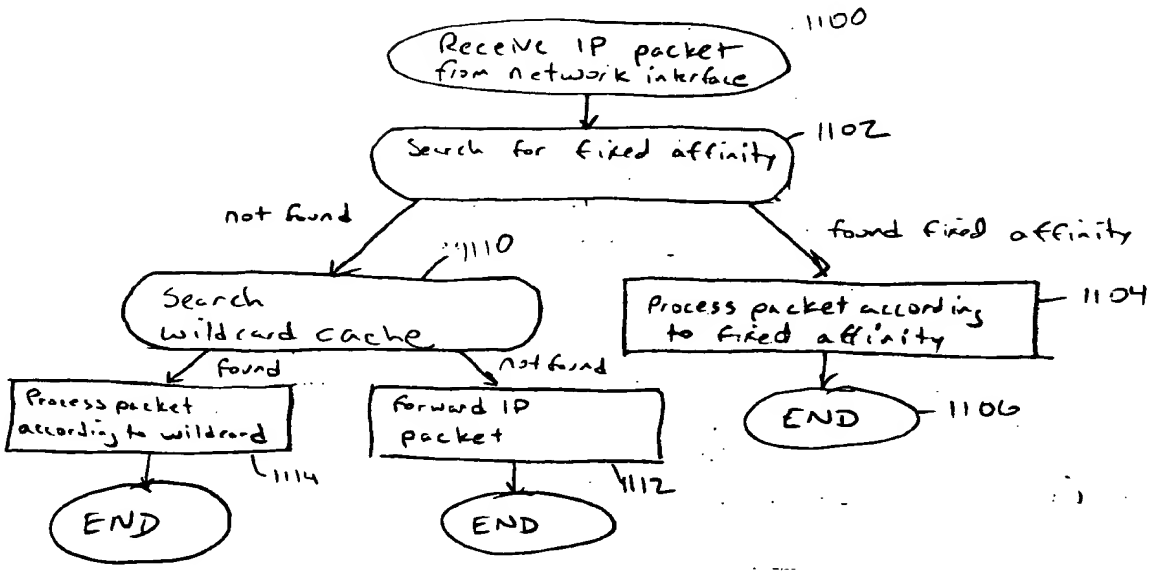
Receive IP packet from network interface
1100
Search for fixed affinity
1102
not found
found fixed affinity
1110
Search wildcard cache
Process packet according to fixed affinity
1104
found
not found
Process packet according to wildcard
1114
Forward IP packet
1112
END
END
END
1106

Figure 11

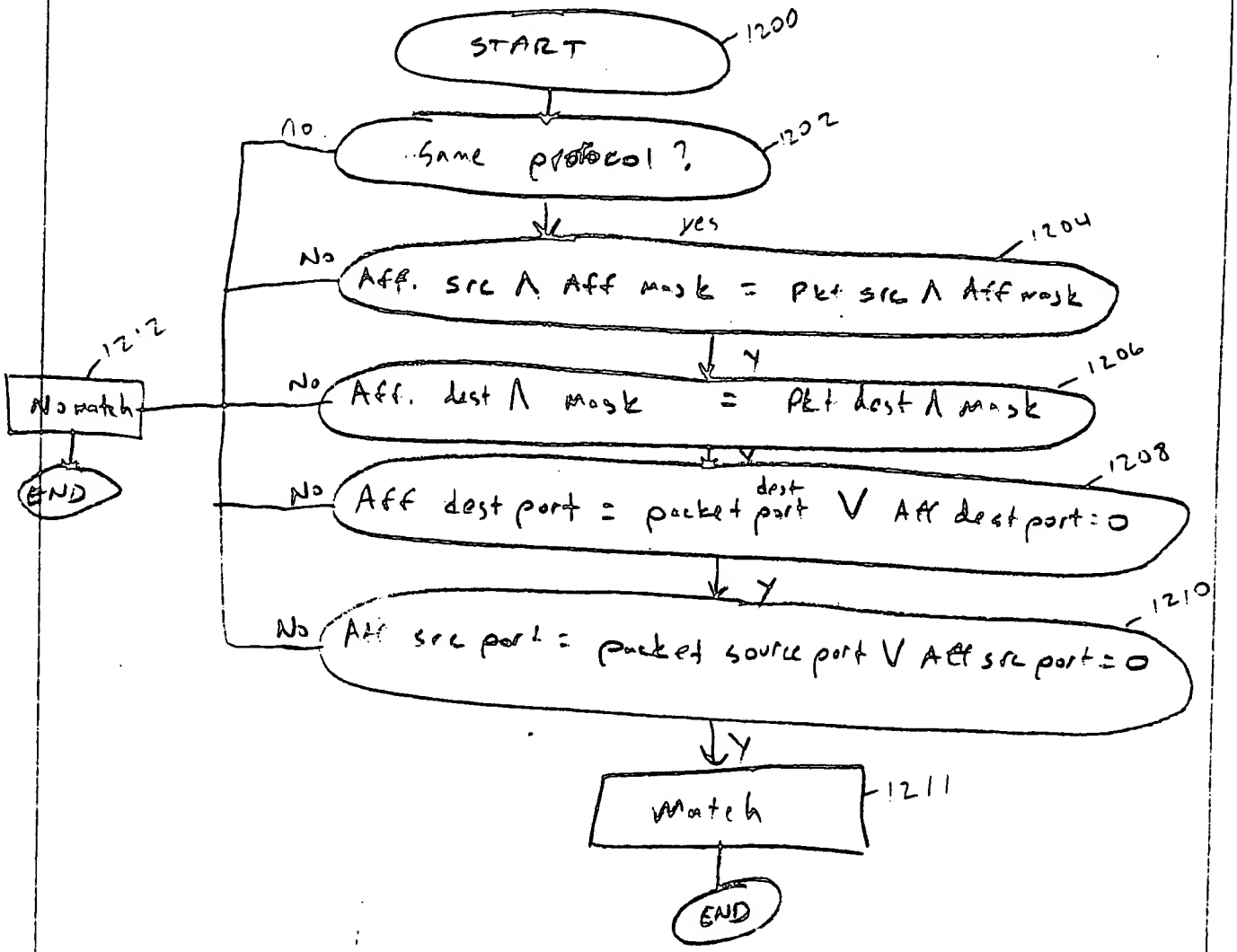
START
1200
Same protocol ?
1202
No
yes
Aff. src ∧ Aff mask = Pkt src ∧ Aff mask
1204
No
Y
Aff. dest ∧ mask = Pkt dest ∧ mask
1206
No
Y
Aff dest port = packet dest port ∨ Aff dest port = 0
1208
No
Y
Aff src port = packet source port ∨ Aff src port = 0
1210
No
Y
Match
1211
END
No match
1212
END

FIG. 12

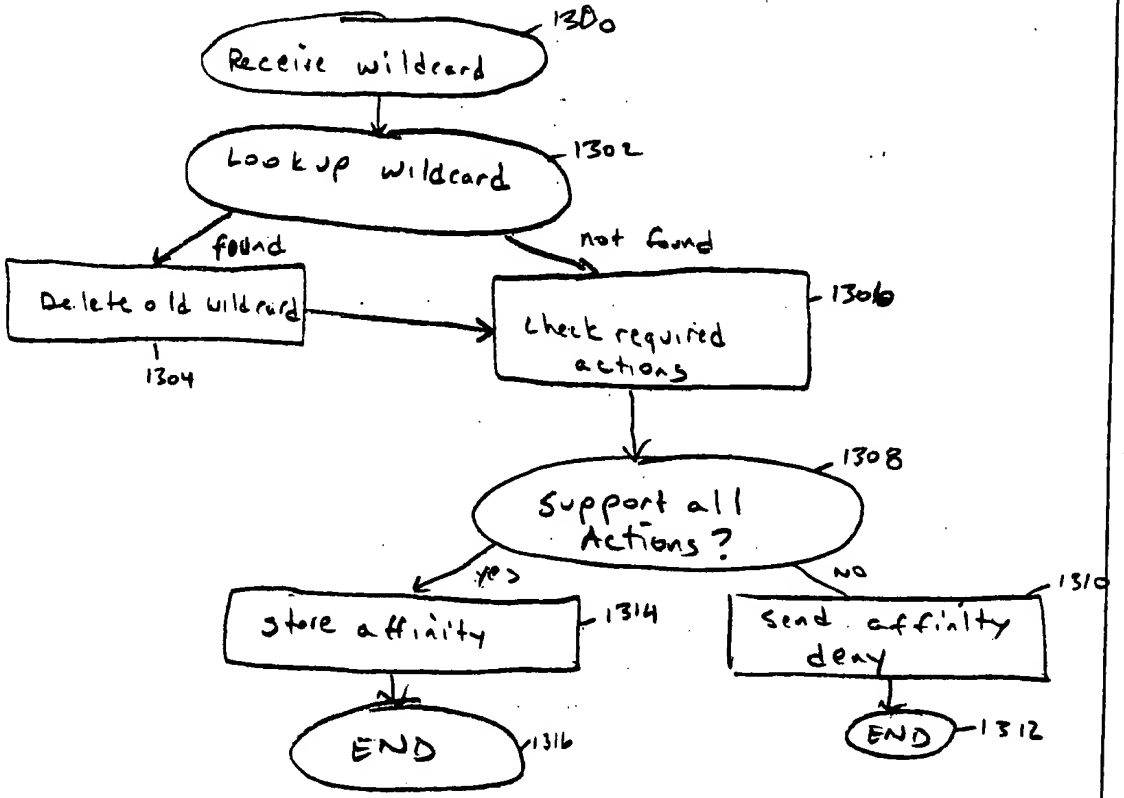
Receive wildcard
1300
Look up wildcard
1302
found
not found
Delete old wildcard
1304
check required actions
1306
Support all Actions?
1308
yes
no
store affinity
1314
send affinity deny
1310
END
1316
END
1312

FIGURE 13

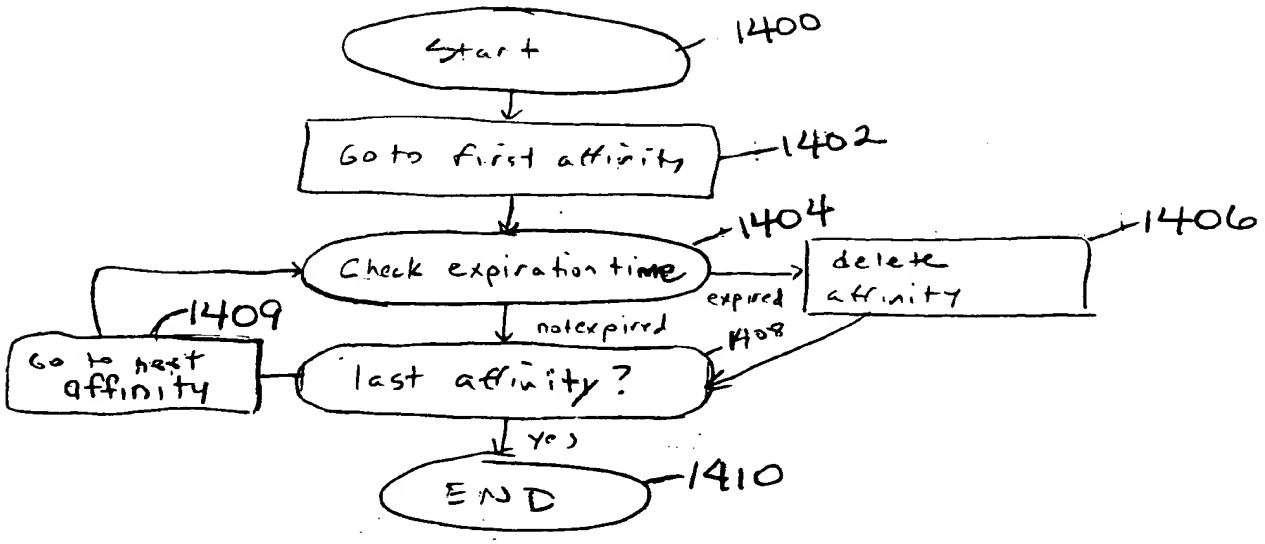
Start
1400
Go to first affinity
1402
Check expiration time
1404
delete affinity
1406
expired
not expired
1409
Go to next affinity
last affinity?
1408
yes
END
1410

FIGURE 14

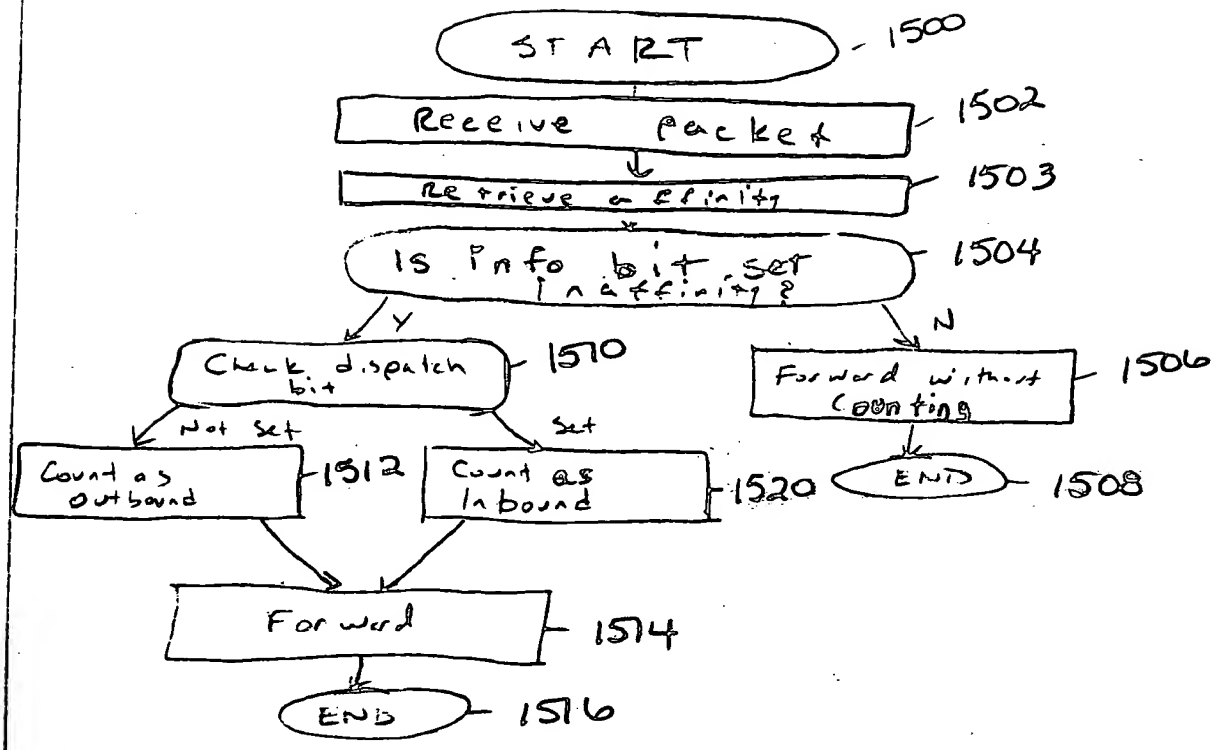
START
1500
Receive packet
1502
Retrieve affinity
1503
Is info bit set in affinity?
1504
Y
N
Check dispatch bit
1510
Forward without counting
1506
Not Set
Set
Count as outbound
1512
Count as Inbound
1520
END
1508
Forward
1514
END
1516

FIGURE 15

Forwarding Address	Info	Dispatch	Action
X	0	X	Dispatch
X	X	0	Count out bound
X	X	X	Count In bound's Dispatch
0	X	X	Count, drop
0	0	X	Drop

FIGURE 16 A

NAT ADDRESS	Info	Dispatch	Action
X	X	X	Count Inbound
X	X	0	Count Outbound
X	0	—	Donot count

FIGURE 16 B

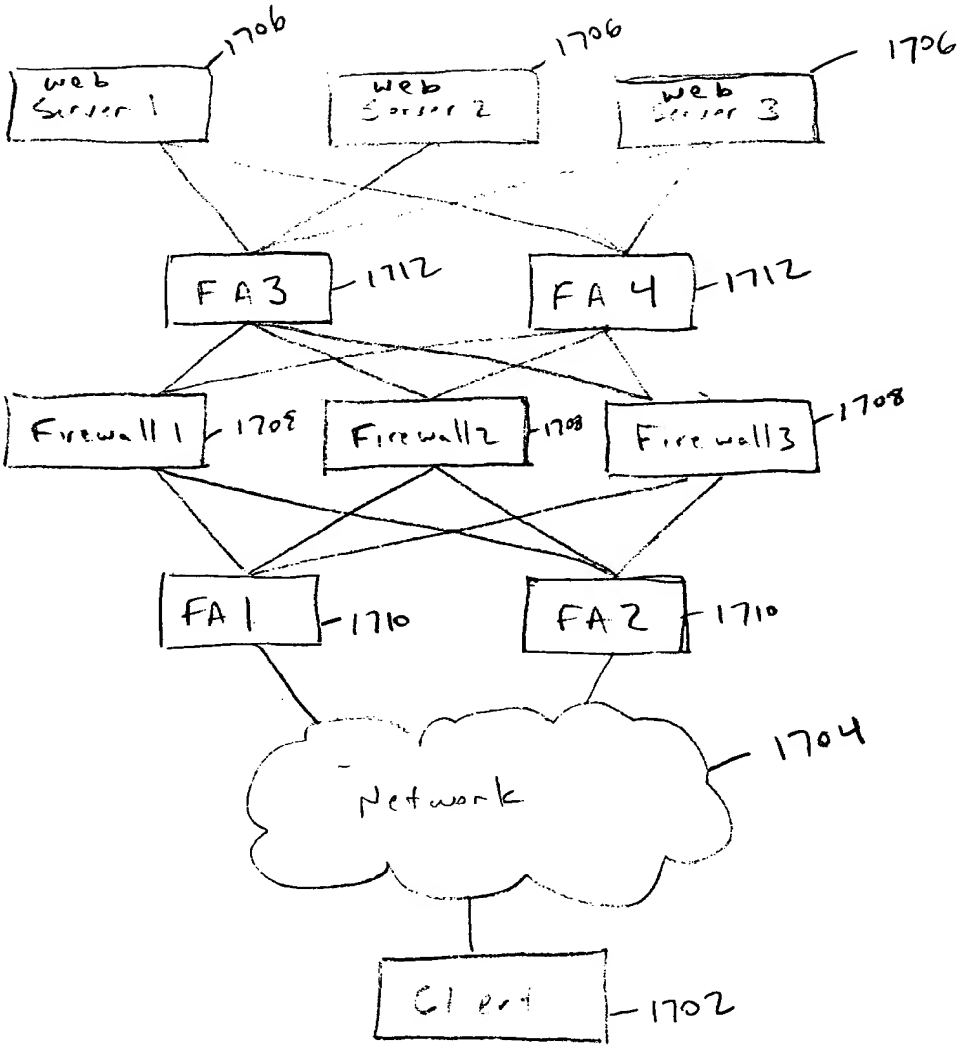

Figure 17

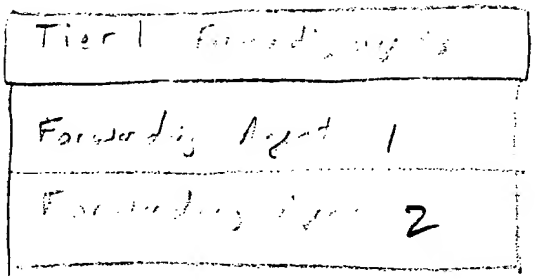

Figure 18 A

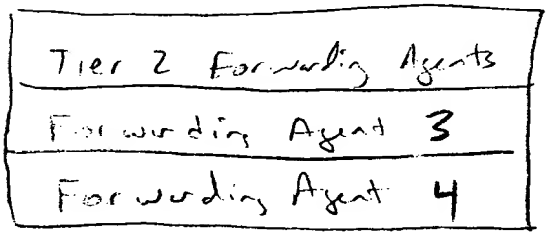

Figure 18 B

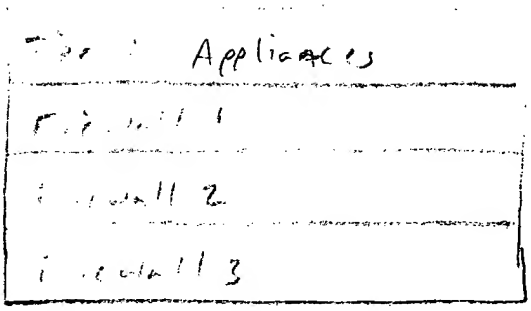

Figure 18C

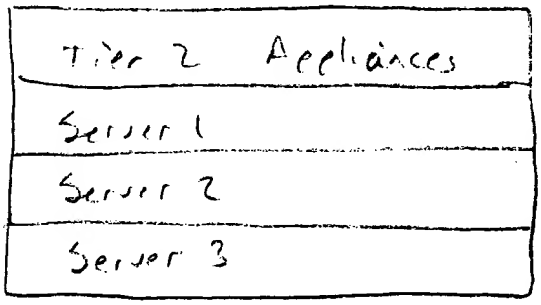

Figure 18 D

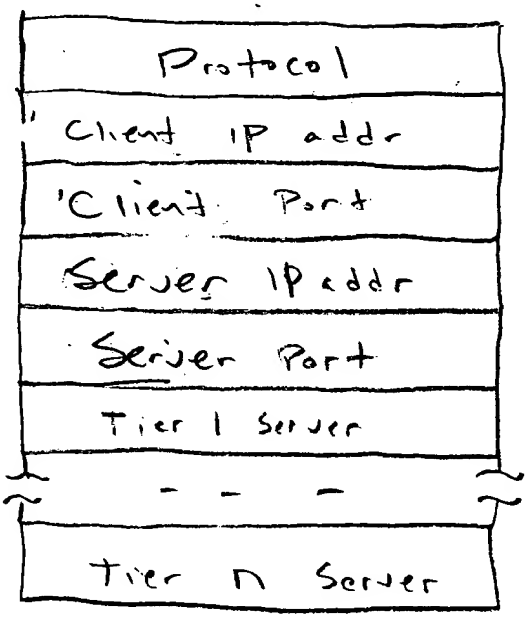

Figure 18 E

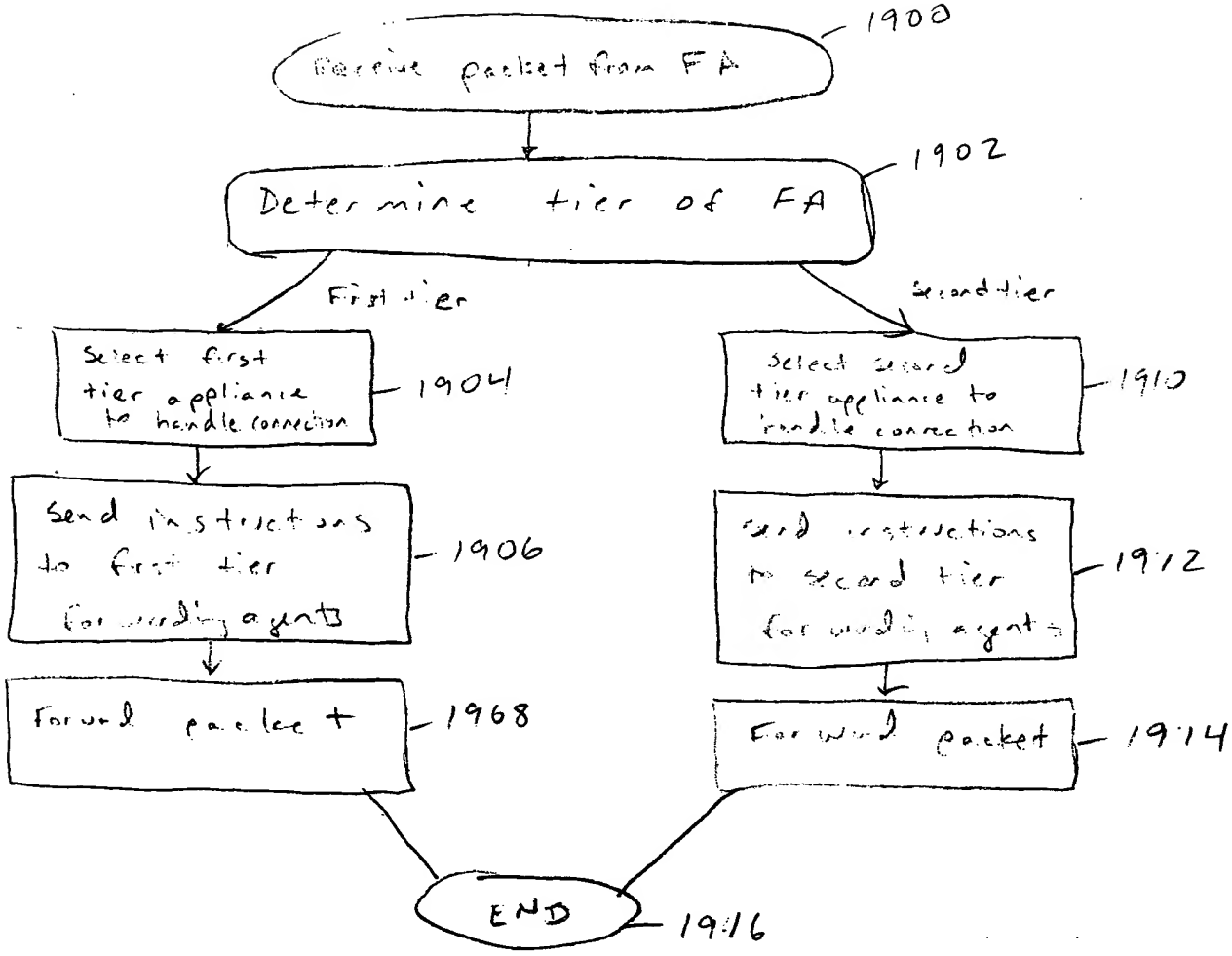
Receive packet from FA
1900
Determine tier of FA
1902
First tier
Second tier
Select first tier appliance to handle connection
1904
Select second tier appliance to handle connection
1910
Send instructions to first tier for forwarding agents
1906
Send instructions to second tier for forwarding agents
1912
Forward packet
1908
Forward packet
1914
END
1916

Figure 19

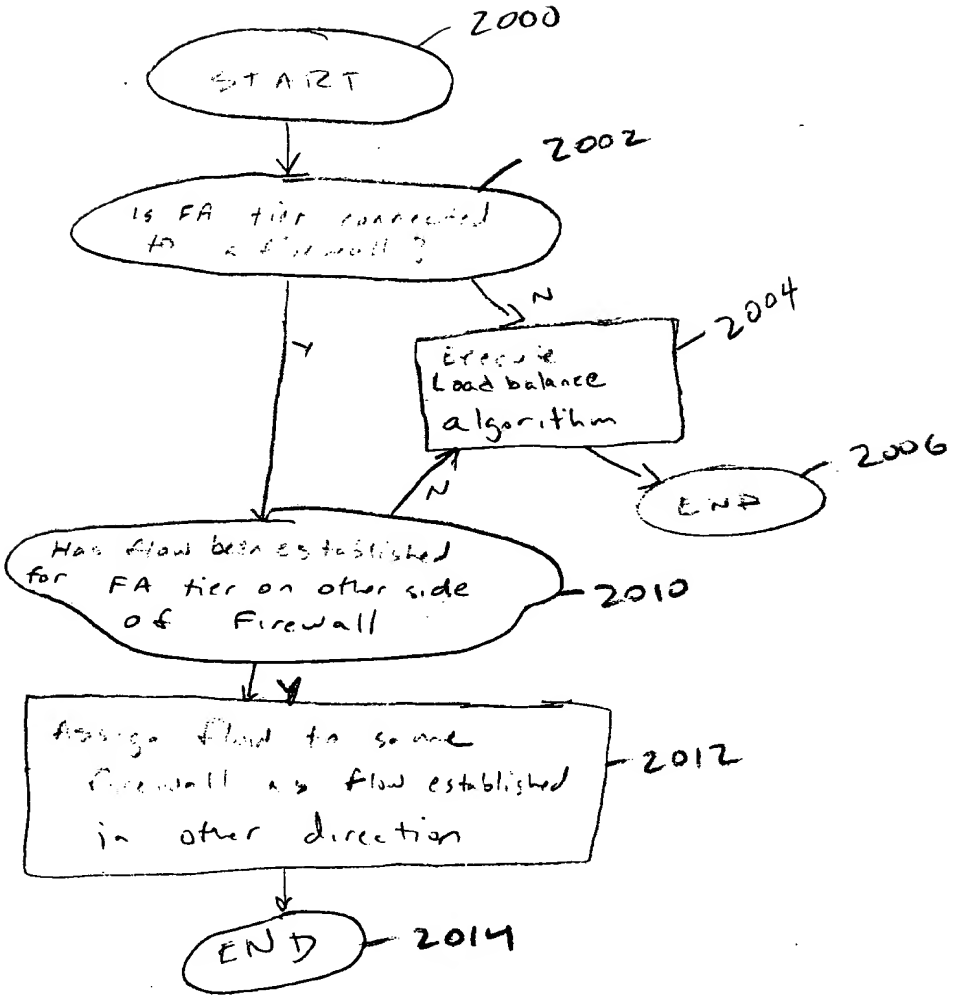
2000
START
2002
Is FA tier connected to a firewall?
Y
N
2004
Execute Load balance algorithm
2006
END
N
Has flow been established for FA tier on other side of Firewall
2010
Y
Assign flow to same Firewall as flow established in other direction
2012
END
2014

Figure 20